WHAT IS CLAIMED IS:

1. A process of producing a purified compressed gas stream comprising:

a) removing impurities from a gas feed stream by passing said gas feed stream through an adsorption sector of a continuously rotating rotary contactor in a direction parallel to an axis of rotation of said rotary contactor resulting in a purified gas and wherein said rotary contactor comprises an adsorbent material;

b) regenerating said continuously rotating rotary contactor by passing a regenerating gas stream through a regeneration sector of said rotating rotary contactor, wherein said regenerating gas stream is at a higher temperature than said gas feed stream;

c) then passing a cooling stream through a cooling sector of said rotating rotary contactor to prepare said rotating rotary contactor for said gas feed stream to pass through said adsorption portion of said continuously rotating rotary contactor; and

d) compressing said purified gas by passing said purified gas through at least one compressor.

2. The process of claim 1 wherein said regenerating gas stream comprises a gas stream that has a lower impurity content than said gas feed stream.

3. The process of claim 1 wherein said regenerating gas flow is co-current to the direction of said gas feed stream.

4. The process of claim 1 wherein said regenerating gas flow is counter-current to the direction of said gas feed stream.

5. The process of claim 1 wherein said cooling gas flow is cocurrent to the direction of said gas feed stream.

6. The process of claim 1 wherein said cooling gas flow is countercurrent to the direction of said gas feed stream.

7. The process of claim 1 wherein said regenerating gas flow is a portion of said purified gas that is diverted to become the regenerating gas flow and is then heated to an appropriate temperature to function as a regenerating gas.

8. The process of claim 1 wherein said cooling gas flow is a portion of said purified gas that is diverted to become the cooling gas flow and is then cooled as necessary to an appropriate temperature to function as a cooling gas.

9. The process of claim 1 wherein said cooling gas flow and said regenerating gas flow are both flowing countercurrent to said gas feed stream.

10. The process of claim 1 wherein said purified gas comprises less than 200 ppm water vapor.

11. The process of claim 1 wherein said purified gas comprises a gas selected from the group consisting of air, light hydrocarbons, nitrogen, carbon dioxide and oxygen.

12. The process of claim 1 wherein said impurities removed from said gas feed stream comprise one or more of the following gases selected from the group consisting of

nitrous oxide, light hydrocarbons, carbon dioxide, light sulfur compounds, hydrochloric acid, mineral acids and water vapor.

13. The process of claim 1 wherein the said compression of said purified gas generates heat that is used to warm said regenerating gas flow.

14 The process of claim 1 wherein the regenerating gas stream comprises a portion of the purified gas stream.

15 The process of claim 1 wherein the cooling gas stream comprises a portion of the purified gas stream.

16. A process of producing a dried gas stream containing less than 200 PPM of water comprising:

a) removing water from a gas feed stream by passing said gas feed stream through an adsorption sector of a continuously rotating rotary contactor in a direction parallel to an axis of rotation of said continuously rotating rotary contactor resulting in a dried gas containing less than 200 PPM of water wherein said rotary contactor comprises an adsorbent material;

b) regenerating said continuously rotating rotary contactor by passing a regenerating gas stream through a sector of said rotating rotary contactor wherein said regenerating gas stream is at a higher temperature than said gas feed stream; and

c) passing a cooling stream through a cooling sector of said rotating rotary contactor to prepare said rotating rotary contactor for said gas feed stream to

pass through said adsorption portion of said continuously rotating rotary contactor.

17. The process of claim 16 wherein said dried gas stream contains less than 100 ppm of water.

18. The process of claim 16 wherein said dried gas stream contains less than 25 ppm of water.

19. The process of claim 16 wherein said gas feed stream is air.

20. The process of claim 16 wherein said regenerating gas flow is counter-current to the direction of said gas feed stream.

21. The process of claim 16 wherein said cooling gas flow is cocurrent to the direction of said gas feed stream.

22. The process of claim 16 wherein said cooling gas flow is countercurrent to the direction of said gas feed stream.

23. The process of claim 16 wherein said gas feed stream is dried prior to compression of said dried gas.

24. A process for purification of a gas feed stream comprising first passing a gas feed stream containing at least one impurity across an adsorption zone of a first continuously rotating rotary adsorbent contactor to produce a partially purified product gas; passing said partially purified product gas across an adsorption zone of a second continuously rotating rotary adsorbent contactor to further purify said partially purified product gas and to produce a highly purified product gas.

25. The process of claim 24 wherein both rotary adsorbers consist of adsorption, regeneration and cooling sector.

26. The process of claim 25 wherein a regeneration stream flowing through the regeneration sector of the second continuously rotating rotary adsorbent contactor comprises a heated portion of the highly purified product gas, and a cooling stream flowing through the cooling sector of the second continuously rotating rotary adsorbent contactor comprises a cooled portion of the highly purified product gas.

27. The process of claim 26 wherein the regeneration stream for the first continuously rotating rotary adsorbent contactor comprises the effluent streams from the cooling and regeneration sectors of the second continuously rotating rotary adsorbent contactor.

28. The process of claim 27 wherein the regeneration stream for the first continuously rotating rotary adsorbent contactor further comprises a stream having the same composition as the gas feed stream.

29. The process of claim 24 wherein the gas feed stream is air.

30. The process of claim 24 wherein at least one impurity is water.

31. The process of claim 24 further comprising passing said highly purified product gas across an adsorption zone of a third continuously rotating rotary adsorbent contactor to further purify said highly purified product gas to produce an ultra high purity product gas.

32. The process of claim 24 comprising passing the partially purified product gas of the first continuously rotating rotary adsorbent contactor across a heat exchanger to

cool said partially purified product gas prior to contact of said partially purified product gas with said second continuously rotating rotary adsorbent contactor.

33. The process of claim 24 wherein said first and said second continuously rotating rotary adsorbent contactors each comprise at least one adsorption sector, at least one regenerating sector and at least one cooling sector.

34. The process of claim 24 wherein said first continuously rotating rotary adsorbent contactor comprises an adsorption zone and a regeneration zone.

35. The process of claim 31 wherein said first continuously rotating rotary adsorbent contactor is contacted with a regenerating stream that is either lower in water content or lower in temperature than said gas feed stream and wherein there is no cooling zone on said first continuously rotating rotary adsorbent contactor.

36. The process of claim 24 wherein said second continuously rotating rotary adsorbent contactor comprises an adsorbent that is selective for removal of water from a gas stream.

37. The process of claim 24 wherein said second continuously rotating rotary adsorbent contactor is selective for removal of carbon dioxide from a dry gas.

38. The process of claim 31 wherein said third continuously rotating rotary adsorbent contactor is selective for removal of carbon dioxide from a dry gas.

39. The process of claim 24 further comprising compression of said purified gas by passing said purified gas through at least one compressor.

40. The process of claim 31 further comprising compression of said purified gas by passing said purified gas through at least one compressor.

41. The process of claim 40 wherein said compression of said purified gas generates heat that is used to warm at least one regenerating gas flow.

42. The process of claim 40 wherein said compression of said purified gas generates heat that is used to warm at least one regenerating gas flow.

43. A system for purifying and compressing a gas feed stream, said system comprising:

a) an inlet for a gas feed stream to convey said gas feed stream to at least one rotary adsorbent contactor comprising at least one adsorbent material to remove at least one impurity from said gas feed stream;

b) connecting means to send said gas feed stream from said rotary adsorbent contactor to a gas compressor; and

c) said gas compressor.

44. The system of claim 43 wherein said rotary adsorbent contactor rotates around an axis of rotation, and wherein said gas feed stream flows in a direction parallel to said axis of rotation through at least one adsorbent sector of said rotary contactor, wherein said impurities are adsorbed within said adsorbent sector of said rotary contactor and wherein a regenerating gas flows through at least one regeneration sector of said rotary contactor, wherein said impurities are desorbed within said second sector of said rotary contactor.

45. The system of claim 44 further comprising a cooling sector of said rotary contactor wherein a flow of gas having a cooler temperature than at least one of the

adsorbent sector or the regeneration sector is passed through said cooling sector of said rotary contactor.

46. The system of claim 44 wherein said regenerating gas flow is co-current to the direction of said gas.

47. The system of claim 44 wherein said regenerating gas flow is counter-current to the direction of said gas.

48. The system of claim 44 wherein said compressed gas is sent to an air separation plant to separate said compressed gas into nitrogen, oxygen and other gases.

49. The system of claim 44 wherein said system produces purified, compressed air is an instrument air drying system.

50. The system of claim 44 wherein said system produces purified, compressed air for an air brake system in a vehicle.

51. The system of claim 44 wherein said adsorbent material is selected from the faujasite, silica gel, alumina and mixtures thereof.

52. The system of claim 51 wherein said faujasite is in the sodium, rare earth, calcium, ammonium, or hydrogen form, or mixtures thereof.

53. The system of claim 44 further comprising a downstream adsorbent wheel located downstream from said compressor to further purify said compressed gas and means to conduct flow of said compressed gas from said compressor to said downstream adsorbent wheel located downstream from said compressor.

54. The system of claim 44 further comprising a second rotary adsorbent contactor to further purify said gas stream.

55. The system of claim 54 further comprising a third rotary adsorbent contactor comprising at least one adsorbent material to produce an ultra high purity product gas.